



US009421618B1

(12) **United States Patent**
Brennan et al.

(10) **Patent No.:** **US 9,421,618 B1**
(45) **Date of Patent:** **Aug. 23, 2016**

(54) **CLAMPING DEVICE FOR SECURING
CABLES TO SUBMERGED FERROUS HULL
SURFACE**

(71) Applicants: **Keith Brennan**, Middletown, MD (US);
Damien Carl Bretall, Baltimore, MD
(US)

(72) Inventors: **Keith Brennan**, Middletown, MD (US);
Damien Carl Bretall, Baltimore, MD
(US)

(73) Assignee: **The United States of America as
represented by the Secretary of the
Navy**, Washington, DC (US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 330 days.

(21) Appl. No.: **14/282,313**

(22) Filed: **May 20, 2014**

(51) **Int. Cl.**
F16L 3/08 (2006.01)
B23B 45/00 (2006.01)
F16L 3/02 (2006.01)

(52) **U.S. Cl.**
CPC .. **B23B 45/00** (2013.01); **F16L 3/02** (2013.01)

(58) **Field of Classification Search**
CPC B63B 45/00; F16L 3/02
USPC 248/51, 74.1, 110, 111, 113, 206.5,
248/316.2, 316.3, 74.2; 114/218
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

1,520,716 A * 12/1924 Judd F16G 11/10
114/218
4,084,532 A * 4/1978 Feder B63B 21/08
114/218

4,195,587 A * 4/1980 Voss B63B 21/08
114/101
4,453,486 A * 6/1984 Harken B63B 21/08
114/218
4,465,011 A * 8/1984 Merry F16G 11/10
114/199
4,766,835 A * 8/1988 Randall F16G 11/10
114/218
4,926,399 A 5/1990 Hickman
5,277,143 A * 1/1994 Frangulea B63B 43/16
114/227
6,016,286 A * 1/2000 Olivier B63B 21/66
114/245
8,554,830 B2 10/2013 Sladojevic
2012/0049020 A1 * 3/2012 Stock F16B 2/10
248/206.5

OTHER PUBLICATIONS

Magnetic Cable Guides, Schweitzer Engineering Laboratories—
Over 20 Years of Engineering, Jun. 26, 2012, http://www.sel-com.com/magnetic_cable_guides.htm.

* cited by examiner

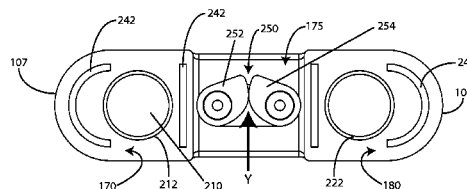
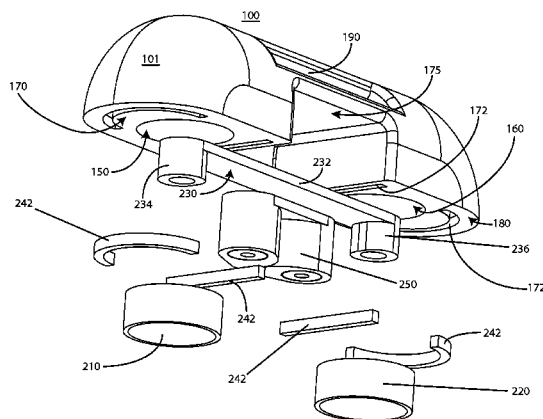
Primary Examiner — Gwendolyn Baxter

(74) *Attorney, Agent, or Firm* — Dave A. Ghatt

(57) **ABSTRACT**

A cable clamping arrangement for securing one or more
cables to a submerged hull surface of a ship. The cable clamp-
ing arrangement includes a plurality of powerful magnetic
clamping devices for attaching signal carrying cables to a
submerged ferrous submerged hull surface. The cable clamp-
ing devices each have a low-profile and are dome shaped to
reduce hydrodynamic interference when the ship is travelling
at operational speeds. The clamps are equipped to grip a cable
in a desired path at a desired tension, thereby increasing the
ability to maintain the cable in a fixed manner on the surface
while the ship is operating.

17 Claims, 8 Drawing Sheets



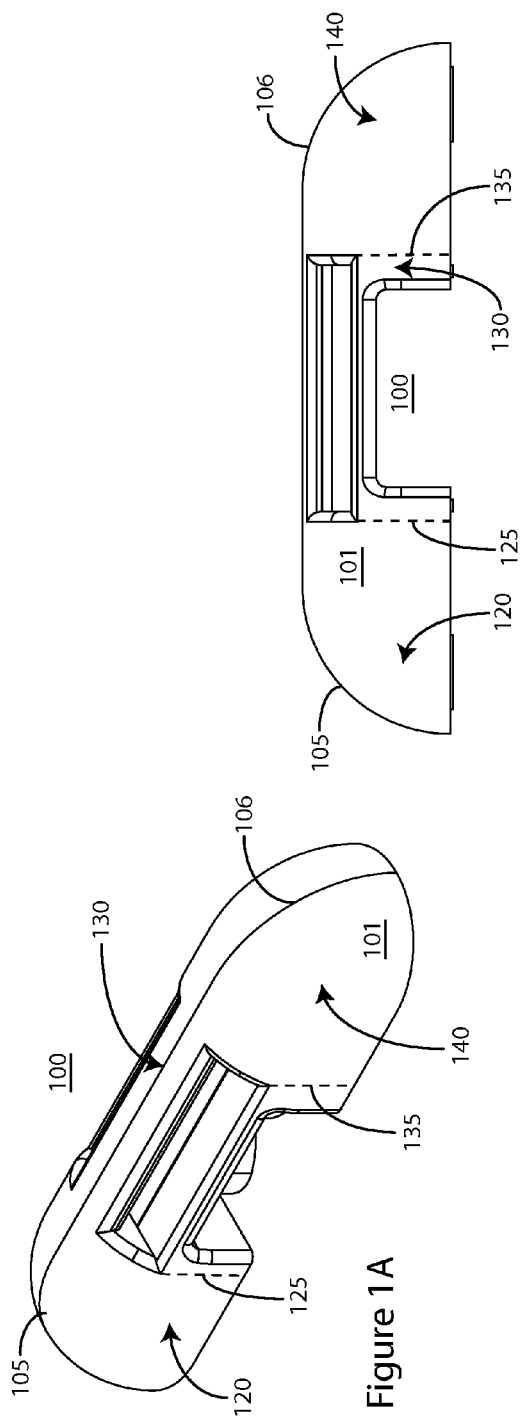


Figure 1A

Figure 1B

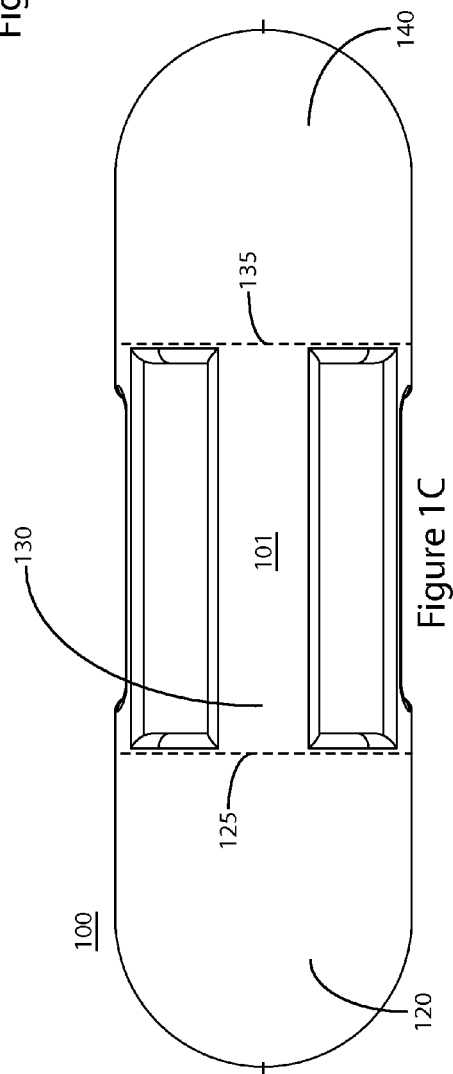
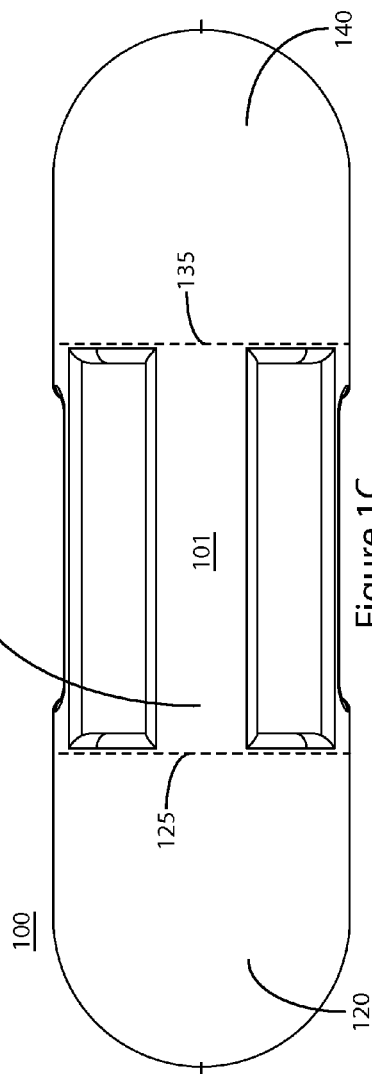


Figure 1C



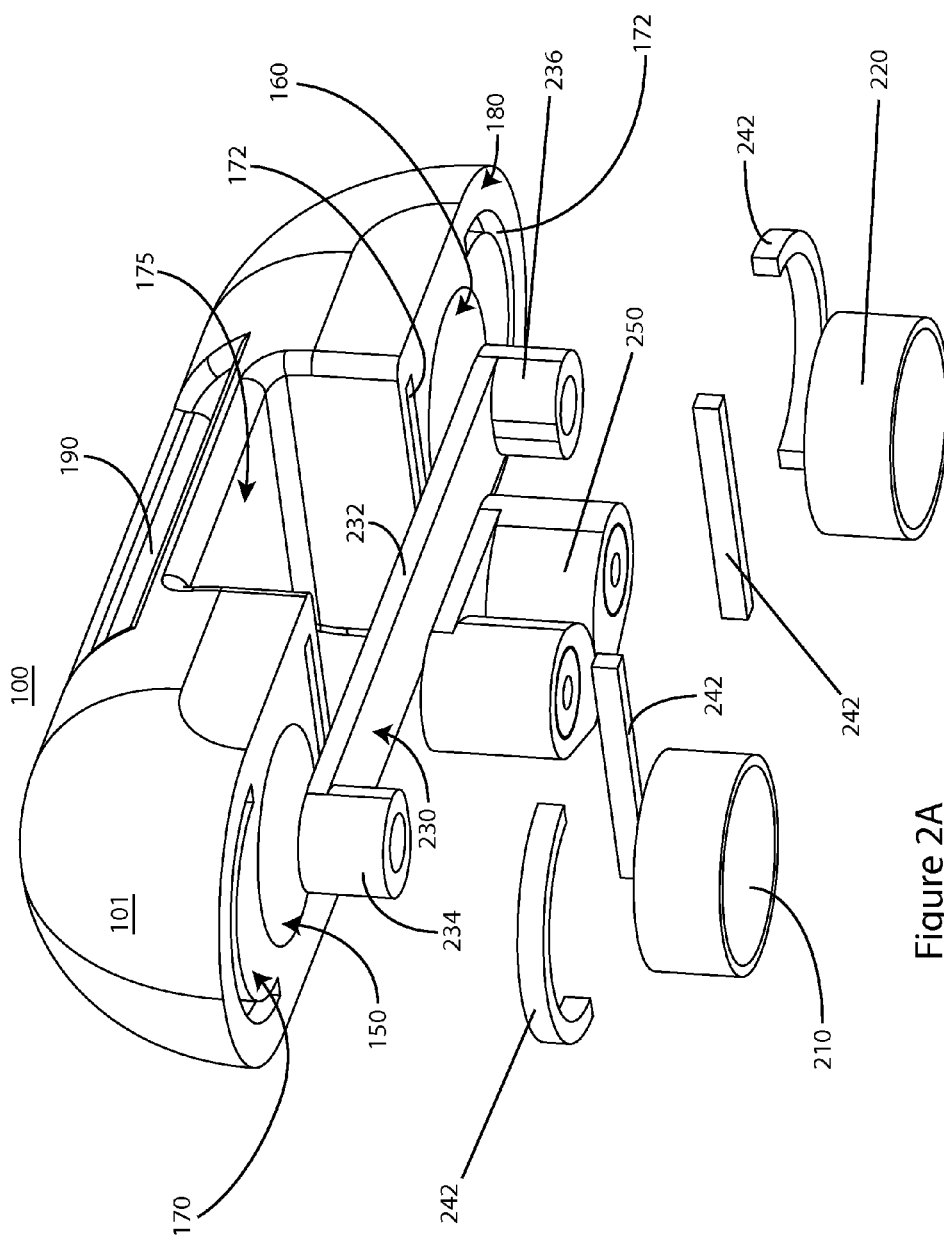
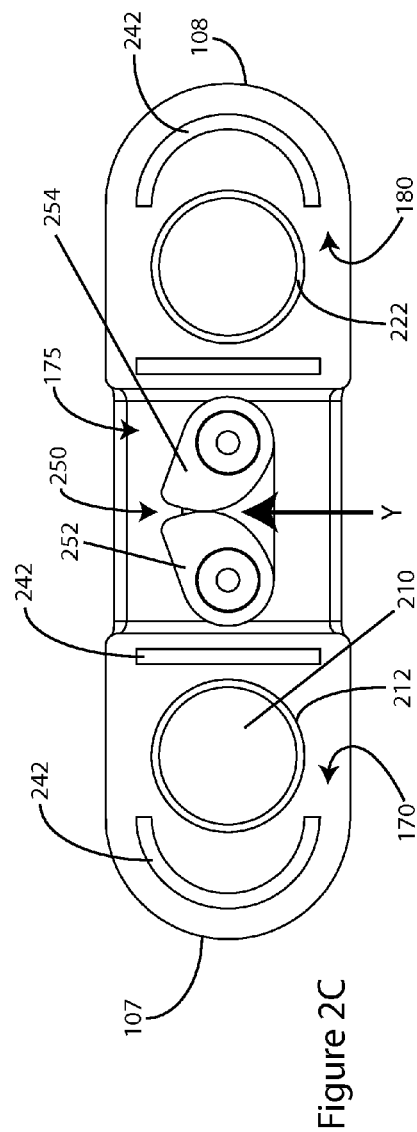
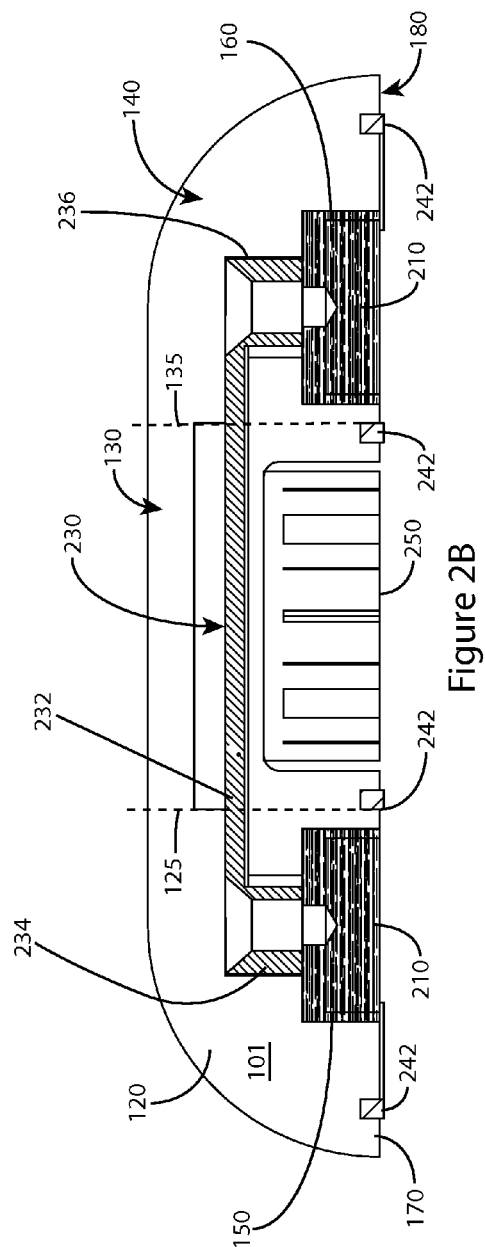
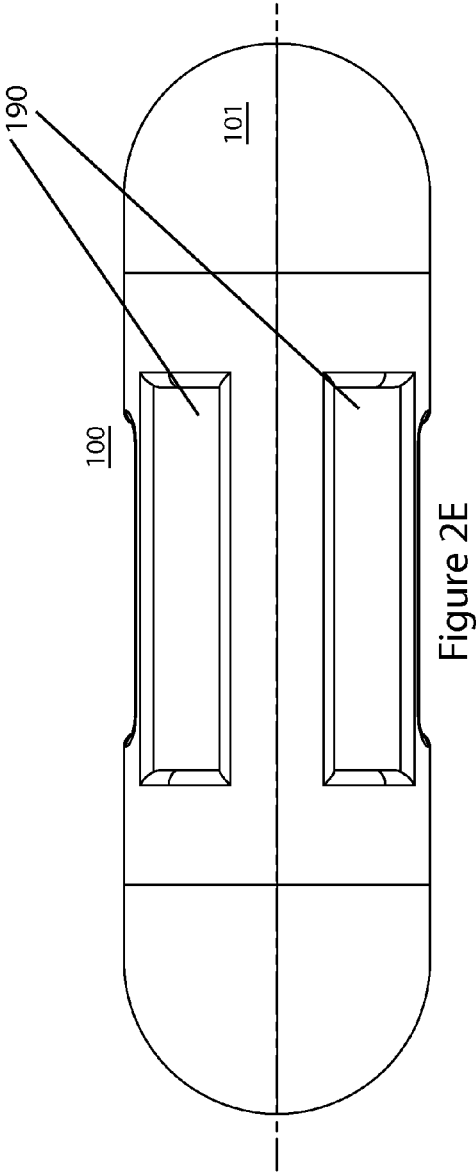
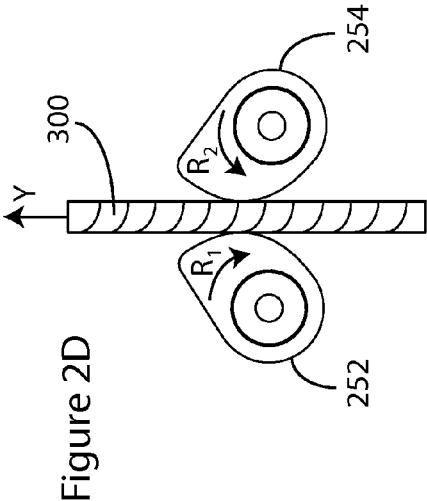


Figure 2A





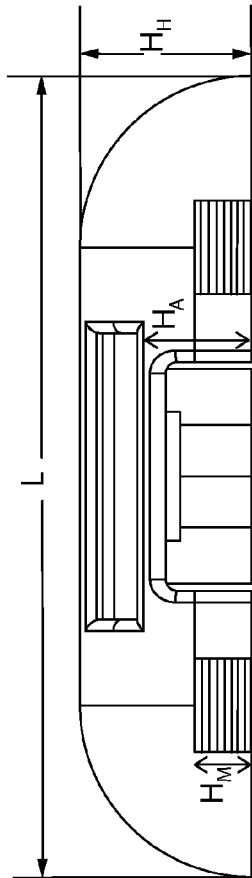


Figure 3A

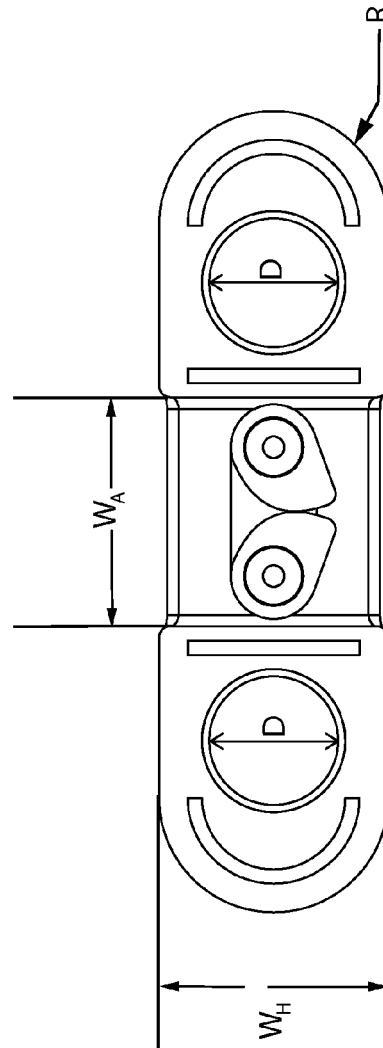


Figure 3B

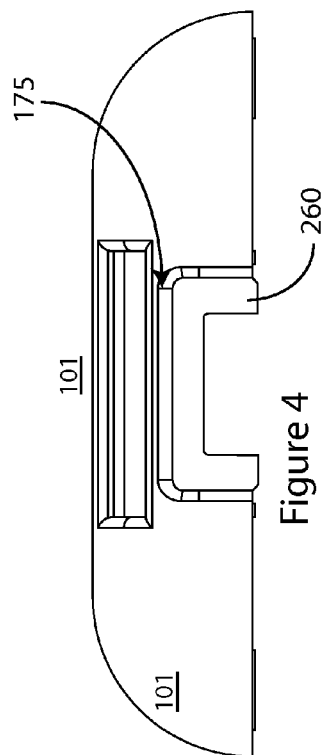


Figure 4

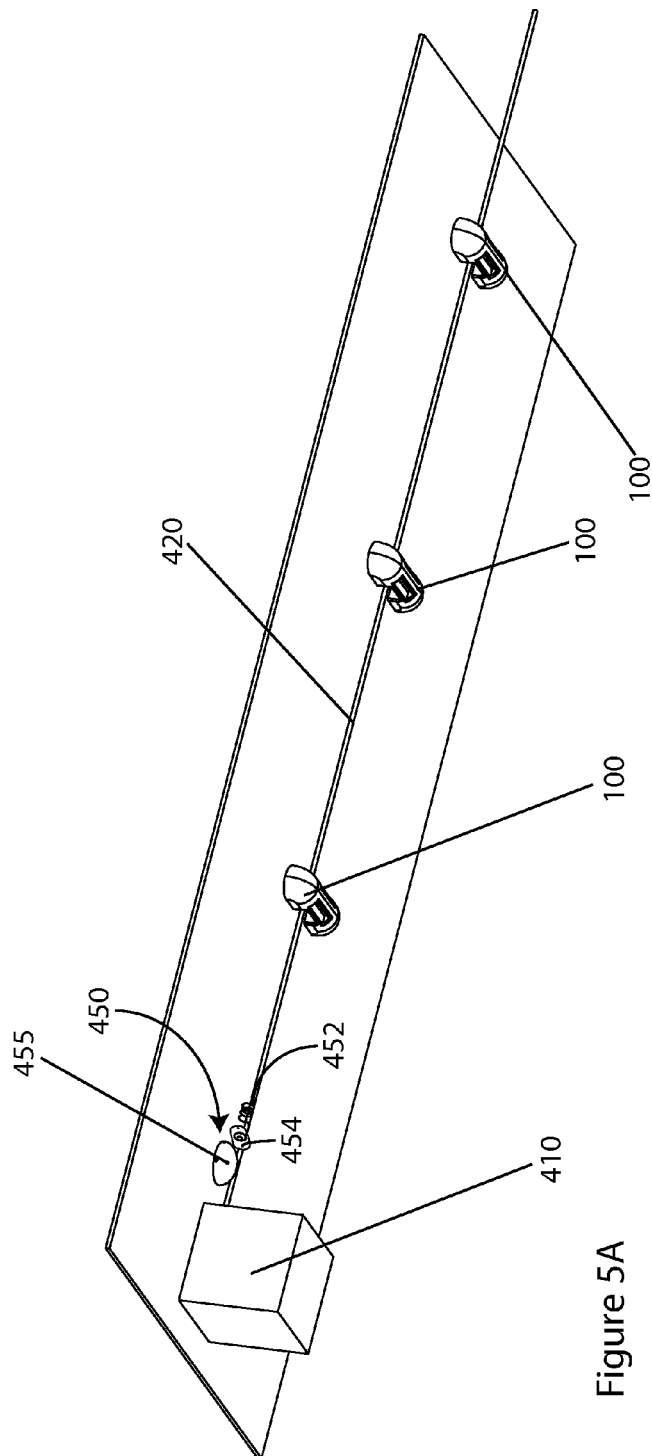


Figure 5A

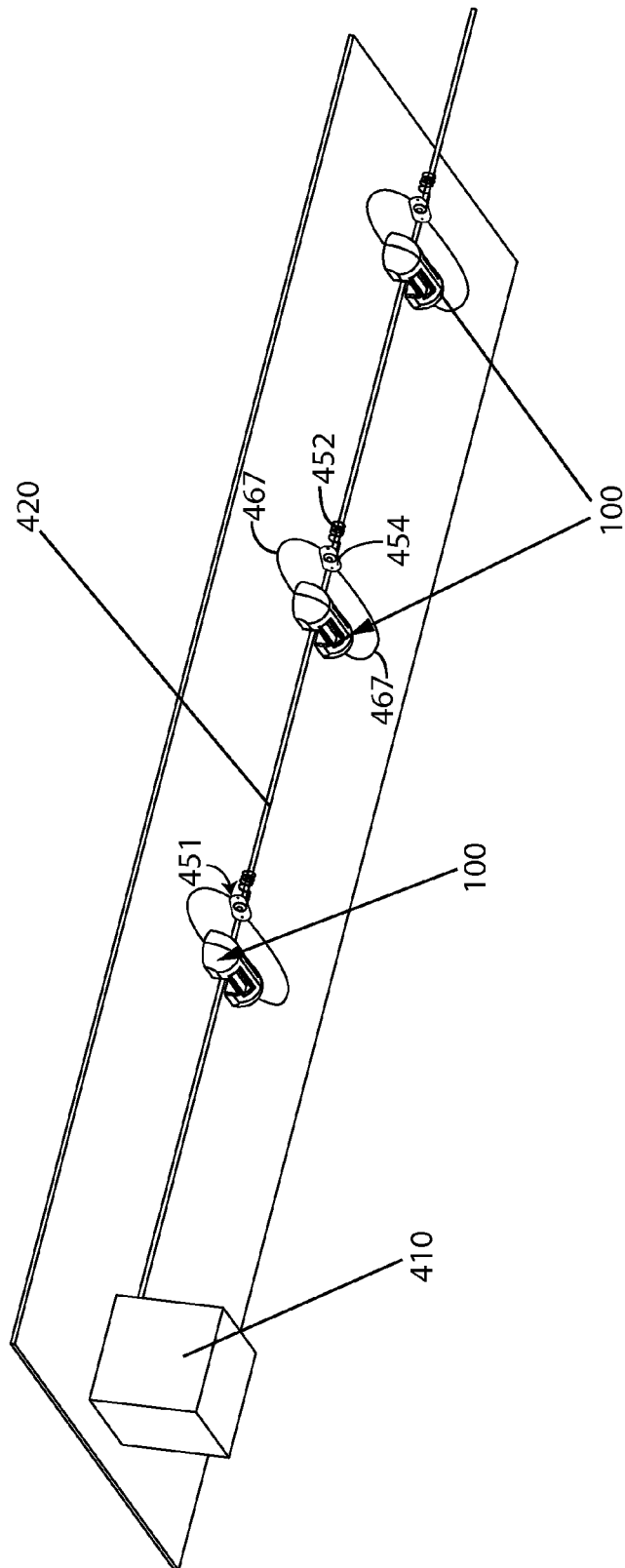


Figure 5B

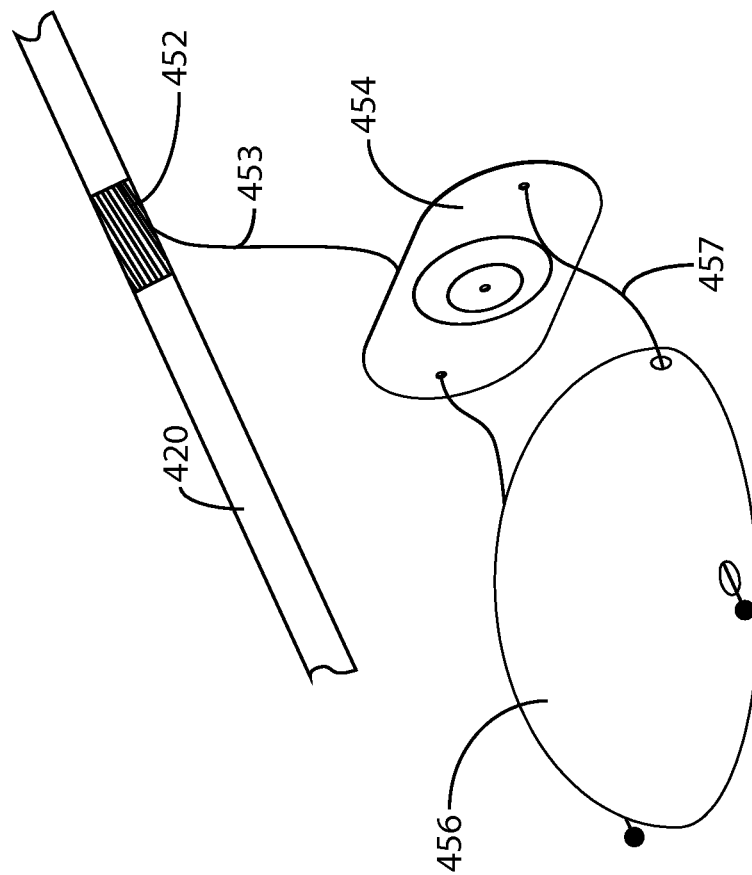


Figure 5C

1

CLAMPING DEVICE FOR SECURING CABLES TO SUBMERGED FERROUS HULL SURFACE

STATEMENT OF GOVERNMENT INTEREST

The following description was made in the performance of official duties by employees of the Department of the Navy, and, thus the claimed invention may be manufactured, used, licensed by or for the United States Government for governmental purposes without the payment of any royalties thereon.

TECHNICAL FIELD

The following description relates generally a cable clamping arrangement for securing a cable to a submerged hull surface, more particularly, a clamping arrangement including a plurality of powerful magnetic clamping devices for attaching signal carrying cables to a submerged ferrous submerged hull surface.

BACKGROUND

During sea trials it is often required to mount data collection devices, such as video cameras and accompanying cables, to the underwater portion of the hull of a ship. These devices may be mounted in a dry dock. Alternatively, the cables may also be mounted using underwater methods by divers. Some installation methods may be applicable to both dry dock environments and underwater environments.

Regardless of the method in which the cables may be secured to the hull, there is a need for improved cable-mounting when the cable is mounted below the ship's waterline for the purpose of underwater operations. For example, a commonly used method for securing cables to the submerged hull surface is to weld attachment points. The welding may be done in a dry dock scenario or may be carried out by underwater welding. Regardless, these permanent welds are very expensive, not easily reversed, and not always possible since the inside of the vessel must be certified as gas free. Another known method is to cut holes in the ship hull, install a waterproof pass-through, and run the cables directly through from the inside of the hull. This is also expensive, and could risk sinking the vessel.

The implementation of magnetic cable fasteners or guides has been used in non-water-related environments. If implemented for submerged hulls it would be beneficial because magnetic cable fasteners would simplify underwater cable installations. However, the prior art does not teach cable fasteners or guides that are robust enough for either underwater installation, or strong enough to work in after-installation applications, such as when the ship is travelling at operational speeds. For example, the prior art teaches a magnetic cable guide, but this device uses a magnet that only has a magnetic force of 2.2 lbs. This will not work in an underwater environment, as it is not strong enough to hold the cable firmly or to prevent damage by strumming since it does not have internal clamping to firmly hold the cable.

Thus it is desired to have a magnetic cable clamp that robust enough for underwater implementation, that can properly clamp and maintain a cable in position even when exposed to working conditions when the ship is traveling at operational speeds. It is also desired to have a clamp that minimizes hydrodynamic drag and that is not easily pulled off the hull when the ship is in operation. It is also desired to have magnetic clamps that are easily and securely installed and

2

easily removed. It is also desired that the signals traveling through the cable are not disturbed by the magnets.

SUMMARY

In one aspect, the invention is a cable clamping device for securing one or more cables to underwater ferrous surfaces. In this aspect, the cable clamping device has a low-profile housing body that is substantially dome shaped. The low-profile housing body includes a first outer section having a first bore for receiving a first magnet and a second outer section having a second bore for a second magnet. The low-profile housing body also includes a middle section having a bottom arch portion defining a cable receiving opening. The middle section extends from the first outer section to the second outer section, wherein the first outer section, the second outer section, and the middle section form a truncated n-shaped side profile. In this aspect, the cable clamping device also includes a first magnet within the first bore, a second magnet within the second bore, and a cable gripping member within the bottom arch portion of the middle section for gripping the cable within the cable receiving opening.

In another aspect, the invention is a cable clamping arrangement for securing a cable to a submerged hull surface. In this aspect the cable clamping arrangement includes a submerged ferrous hull surface, a cable for carrying signals, a plurality of cable clamping devices, and a cable tension sensor for determining when the cable is secured at a desired tension. In this aspect, the cable clamping devices are magnetically attached to submerged ferrous hull surface, wherein the cable is held along the submerged ferrous hull surface in a desired path by the plurality of cable clamping devices. According to the invention, the cable is in working contact with the cable tension sensor ensuring that the cable is extended at the desired tension. Each of the plurality of cable clamping devices has a low-profile housing body that is substantially dome shaped. The low-profile housing body has a first outer section having a first bore for receiving a first magnet, a second outer section having a second bore for a second magnet, and a middle section having a bottom arch portion defining a cable receiving opening. The middle section extends from the first outer section to the second outer section, wherein the first outer section, the second outer section, and the middle section form a truncated n-shaped side profile. In this aspect, each cable clamping device further includes a first magnet within the first bore, a second magnet within the second bore, and a cable gripping member within the bottom arch portion of the middle section for gripping the cable within the cable receiving opening.

BRIEF DESCRIPTION OF THE DRAWINGS

Other features will be apparent from the description, the drawings, and the claims.

FIG. 1A is an exemplary perspective view of a cable clamping device for securing cables to underwater ferrous surfaces, according to an embodiment of the invention.

FIG. 1B is an exemplary side view of a cable clamping device for securing cables to underwater ferrous surfaces, according to an embodiment of the invention.

FIG. 1C is an exemplary top view of a cable clamping device for securing cables to underwater ferrous surfaces, according to an embodiment of the invention.

FIG. 2A is an exemplary exploded view of the cable clamping device, according to an embodiment of the invention.

3

FIG. 2B is an exemplary side section view of the cable clamping device, showing the elements in an assembled state, according to an embodiment of the invention.

FIG. 2C is an exemplary bottom view of the cable clamping device, showing the elements in an assembled state, according to an embodiment of the invention.

FIG. 2D is an exemplary bottom view of the gripping member as it receives a cable, according to an embodiment of the invention.

FIG. 2E is an exemplary top view of the cable clamping device, showing the elements in an assembled state, according to an embodiment of the invention.

FIG. 3A is an exemplary side view of the cable clamping device showing dimensions, according to an embodiment of the invention.

FIG. 3B is an exemplary bottom view of the cable clamping device showing dimensions, according to an embodiment of the invention.

FIG. 4 is an exemplary illustration of the cable clamping device, according to an embodiment of the invention.

FIG. 5A is an exemplary illustration of a cable clamping arrangement for securing a cable to a submerged hull surface, according to an embodiment of the invention.

FIG. 5B is an exemplary illustration of a cable clamping arrangement for securing a cable to a submerged hull surface, according to an embodiment of the invention.

FIG. 5C is an exemplary illustration of the cable tension sensor, according to an embodiment of the invention.

DETAILED DESCRIPTION

FIG. 1A is an exemplary perspective view of a cable clamping device 100, according to an embodiment of the invention. FIGS. 1B and 1C show side and top views, respectively, of the cable clamping device. It should be noted that FIGS. 1A, 1B, and 1C show the general structure and shape of the cable clamping device 100. Subsequent figures will highlight the individual elements and features of the clamping device 100.

As outlined below, the cable clamping device 100 is for securing cables, such as data and video cables, to underwater ferrous surfaces. The underwater ferrous surface may be a submerged vessel surface such as the hull of a ship. The clamping device 100 secures the cable in a manner that allows the cable to withstand hydrodynamic forces created when the vessels are operating throughout their full range of speeds. FIGS. 1A, 1B, and 1C all show the low-profile housing 101 of the cable clamping device 100, having rounded edges 105 and 106, the housing 101 being substantially dome shaped. This low-profile rounded structure reduces hydrodynamic drag when the vessel is operating. It should be noted that although the cable clamping device 100 with the low-profile housing 101 is particularly designed to withstand hydrodynamic forces when submerged on travelling water vessel, the cable clamping device 100 may be used in above-water applications, i.e., in situations when the device 100 is not submerged.

As stated above, FIGS. 1A, 1B, and 1C show the general structure of the cable clamping device 100. The low-profile housing 101 may be broken up into three sections as shown. FIGS. 1B and 1C show the low-profile housing having a first outer section 120, a middle section 130, and a second outer section 140. As shown, the sections are divided by imaginary (dotted) lines 125 and 135. As shown, the middle section 130 extends from the first outer section 120 to the second outer section 140. As shown in the side view of FIG. 1B, the first outer section 120, the second outer section 140, and the middle section 130 form a truncated n-shaped side.

4

FIG. 2A is an exemplary exploded view of the cable clamping device 100, according to an embodiment of the invention. The FIG. 2A depiction shows the different elements of the device 100. FIG. 2A shows the low-profile housing 101 being substantially dome shaped. As shown, the low-profile housing 101 has a first bore 150 and a second bore 160. The low-profile housing 101 includes a first substantially flat base portion 170 and a second substantially flat base portion 180. The first substantially flat base portion 170 and the second substantially flat base portion 180 are separated by a bottom arch portion 175. As shown, the bottom arch portion 175 is between the first substantially flat base portion 170 and the second substantially flat base portion 180, hence the truncated n-shaped side profile outlined above. The bottom arch portion 175 defines a cable receiving opening through which a cable is threaded and gripped. It should be noted that the bottom arch portion 175 and accompanying elements may also be dimensioned to thread and grip a plurality of cables simultaneously. The substantially flat base portions 170 and 180 both include grooves 172. The grooves may be linear and/or curved, but may also have other shapes. The low-profile housing 101 also includes handle grooves 190, which allow for easy installation and removal by hand.

The exploded illustration of FIG. 2A also shows a first magnet 210 for the first bore 150 and a second magnet 220 for the second bore 160. FIG. 2A also shows a faraday cage 230, which as outlined below, prevents the first and second magnets (210, 220) from interfering with any signal travelling through a cable that is clamped by the device 100. The faraday cage 230 includes a flat elongated steel bar 232 having a first connecting protrusion 234 at one end and a second connecting protrusion 236 at the other end. FIG. 2A also shows pads 242, which as outlined below are for the grooves 172, and like the grooves 172 may be linear and/or curved, but may also have other shapes. FIG. 2A also shows a cable gripping member 250.

FIG. 2B is an exemplary side section view of the cable clamping device 100, showing the elements in an assembled state, according to an embodiment of the invention. FIG. 2B also shows imaginary lines 125 and 135 demarking the first outer section 120, the middle section 130, and the second outer section 140. FIG. 2B shows the first magnet 210 within the first bore 150 in the first outer section 120 of the housing 101. The second magnet 220 is within the second bore 160 in the second outer section 140 of the housing 101. The first and second magnets 210 and 220, extend through the first and second bores 150 and 160 enough so that they are exposed at the respective substantially flat base portions 170 and 180. Thus when the device 100 is attached to a surface the magnets 210 and 220 contact the surface. As outlined below, the magnets 210 and 220 may be high-pull rare earth magnets, and may be encased by an outer steel ring. The magnets do not have to be made of rare earth materials as long as they are of sufficient strength.

FIG. 2B shows the faraday cage 230. As outlined above, the faraday cage prevents the first and second magnets (210, 220) from interfering with any signal travelling through a cable that is clamped by the device 100. The faraday cage 230 includes a flat elongated steel bar 232 having a first connecting protrusion 234 connected to the first magnet 210. The second connecting protrusion 236 at the other end of the elongated steel bar 232 is connected to the second magnet 220. FIG. 2B shows the faraday cage 230 positioned within the low-profile housing body 101, extending from the first outer section 120, through the middle section 130, to the second outer section 140. FIG. 2B shows screws 211 and 221 connecting magnets 210 and 220 to the respective connecting

5

protrusions **234** and **236**, and maintaining the magnets **210** and **220** and the faraday cage **230** within the housing **101**. It should be noted that as opposed to the screws **211** and **221**, other connectors may also be used to attach the magnets **210** and **220** to the connecting protrusions **234** and **236**. Additionally, adhesives may also be used to securely maintain the magnets **210** and **220** and the connecting protrusions **234** and **236** within the housing **101**.

FIG. 2B also shows the cable gripping member **250** within the bottom arch portion **175** of the middle section **130** for gripping the cable within the cable receiving opening. As outlined below, the cable gripping member may be a first rotatable cable cam **252** biased to rotate in a first direction, and a second rotatable cable cam **254** biased to rotate in a second direction opposite to first direction. In operation, the cable extends between the first and second rotatable cable cams **252** and **254**. FIG. 2B also shows pads **242**, which are fastened in the grooves **172**. As stated above, the pads **242** and grooves **172** may be linear and/or curved, but may also have other shapes. The pads **242** may be made from a rubber material, and in operation they contact the submerged hull surface, increasing friction between the cable clamping device **100** and the surface, thus preventing sliding of the cable clamping device **100**. They may also be made from other high-friction material.

FIG. 2C is an exemplary bottom view of the cable clamping device **100**, according to an embodiment of the invention. The bottom view of FIG. 2C illustrates the different elements as arranged at the bottom of the cable clamping device **100**. FIG. 2C shows the first substantially flat base portion **170** and the second substantially flat base portion **180**. As shown, the first substantially flat base portion **170** and the second substantially flat base portion **180** are separated by a bottom arch portion **175**. The first substantially flat base portion **170** houses the first magnet **210** and rubber pads **242**. The second substantially flat base portion **180** houses the first magnet **220** and rubber pads **242**. As shown, the magnets **210** and **212** may optionally be encased in outer steel rings **212** and **222**. FIG. 2C also show the outer edge portions **107** and **108** of the substantially flat base portions **170** and **180**, respectively, being substantially concentric with the cylindrical magnets **210** and **220**. It should be noted that although the magnets **210** and **220** are cylindrical, according to other embodiments, the magnets may have other shapes.

As outlined above, the bottom arch portion **175** defines a cable receiving opening through which one or more cables may be threaded and gripped. FIG. 2C shows the cable gripping member **250** being a first rotatable cable cam **252** biased to rotate in a first direction R_1 as shown, and a second rotatable cable cam **254** biased to rotate in a second direction R_2 opposite to first direction. Arrow **Y** shows the direction in which a cable approaches and is threaded between first and second rotatable cams **252** and **254**.

FIG. 2D is an exemplary bottom view of the gripping member **250** as it receives a cable **300**, according to an embodiment of the invention. As illustrated, the cable **300** enters in direction **Y** and pushes the first and second rotatable cams **252** and **254**, which forces the cams to rotate in directions opposite to their respective predisposed rotation directions R_1 and R_2 . As the cable **300** extends between the first and second rotatable cable cams **252** and **254**, the cable is maintained at a desired tension as the cams are biased to rotate in the respective rotation directions R_1 and R_2 . This prevents the cable **300** from slipping or from excessively vibrating when the ship is travelling at operational speeds.

Although FIG. 2D shows only one cable **300**, the cable gripping member **250**, i.e., the first and second rotatable cable

6

cams **252** and **254**, may be dimensioned to grip a plurality of cables **300** simultaneously, along their respective outer surfaces of the cams **252** and **254**. According to this embodiment, the cables are vertically stacked as they are threaded and gripped by the cams **252** and **254**. Thus, for example, first and second rotatable cable cams **252** and **254** may simultaneously grip two vertically stacked cables **300**. The ability to simultaneously grip a plurality of cables **300** may depend on the size of the cables **300** with respect to the size and outer surface area of the cams **252** and **254**.

FIG. 2E is an exemplary top view of the cable clamping device **100**, according to an embodiment of the invention. The top view of FIG. 2E shows the first and second elongated handle grooves **190** in the middle section of the housing **101**, forming a handle. A diver or other operator may use the handles to hold and carry the cable clamping device **100**. The handle grooves **190** also act as pry-points, facilitating the removal of the clamping device **100** from the submerged surface.

FIG. 3A is an exemplary side view of the cable clamping device **100** showing dimensions, according to an embodiment of the invention. FIG. 3B is an exemplary bottom view of the cable clamping device **100** showing dimensions, according to an embodiment of the invention. The low-profile rounded structure of the clamping device, as well as the dimensions helps to reduce hydrodynamic drag when the device **100** is attached to a vessel that is travelling at operational speeds. FIG. 3A shows the housing **101** having a length L and a height H_H . FIG. 3A also shows the bottom arch portion **175** having a height H_A . FIG. 3B shows the housing **101** having a housing width W_H . FIG. 3A shows the magnets **210** and **220** having a height H_M . FIG. 3B also shows the bottom arch portion **175** having a width W_A , defining the width of the cable receiving opening through which a cable is threaded and gripped. FIG. 3B shows both of the first and second magnets **210** and **220** having a diameter D . FIG. 3B also shows the outer edge portions **107** and **108** having a radius of curvature R .

The dimensions of the housing **101** may be varied according to the application and environment. However, according to a particular embodiment of the invention, the housing **101** has a length L of about 7 in., a height H_H of about 1.50 in., a housing width W_H of about 2 in., and an arch width W_A of about 2 in. According to this embodiment, the bottom arch portion height H_A is about 0.75 in. The outer edge portions **107** and **108** have a radius of curvature R of about 1 in. According to this particular embodiment, the magnets **210** and **220** have a diameter D of about 1.27 in., and a height H_M of about 0.5 in. According to this embodiment, the magnets **210** and **220** are high-pull rare earth magnets, each having a pull of at least 50 lbs. The powerful magnets **210** and **220** provide the necessary force to securely attach the clamping device **100** to ferrous surfaces. In addition to this attaching force, as stated above, the low-profile rounded structure of the clamping device, as well as the dimensions helps to reduce hydrodynamic drag, thereby maintaining the device **100** on ferrous hull surfaces even when the vessel is travelling at operational speeds.

FIG. 4 is an exemplary illustration of the cable clamping device **100**, according to an embodiment of the invention. The elements of the cable clamping device **100** are as outlined above, except the cable gripping member **250** is replaced by cable gripping member **260**. As with gripping member **250**, the cable gripping member **260** is placed within the bottom arch portion **175** of the middle section **130**. The cable gripping member **260** may be a foam insert or a rubber insert lining the bottom arch portion **175**. In operation, the insert **260** presses against and grips the cable, thereby preventing

the cable from slipping or excessively vibrating. Depending on the dimensions of the foam or rubber insert **260**, a plurality of cables may be gripped simultaneously. According to this embodiment, the simultaneously gripped cables **300** may be horizontally stacked.

FIG. **5A** is an exemplary illustration of a cable clamping arrangement **400** for securing a cable to a submerged hull surface, according to an embodiment of the invention. FIG. **5A** shows a submerged ferrous hull surface **401**, which as outlined above may be the hull surface of a ship. FIG. **5A** also shows a data collection device **410**, such as a camera. A signal carrying cable **420** extends from the device **410**. The signal carrying cable **420** may be a coaxial or a High Definition Multimedia Interface (HDMI) for example. FIG. **5A** also shows a plurality of cable clamping devices **100**, gripping and clamping the cable **420** to the submerged ferrous hull surface **401**. The features of each of the plurality of cable clamping devices **100** shown in FIG. **5A** are as outlined above with respect to FIGS. **1A-4**. It should be noted that although Figure **5A** only shows three clamping devices, any desired number of clamping devices may be used, depending on the length of the cable **420** and the desired tension levels for the cable **420**.

As shown, the cable **420** is held taut in a desired path by the clamping devices **100** as it extends over the surface **401**. The plurality of cable clamping devices **100** clamp down on the cable **420** maintaining the cable at a desired amount of tension. The cable clamping arrangement **400** shown in FIG. **4** also includes a cable tension sensor **450** for determining when the cable is secured at a desired tension. According to an embodiment of the invention, the cable tension sensor **450** has a noose **452** through which the cable is threaded. The sensor **450** may also include an audio clicker **454**.

FIG. **5C** is an exemplary illustration of the cable tension sensor **450** showing elements of the sensor **450**, according to an embodiment of the invention. FIG. **5C** shows the sensor **450** with the noose **452** which is wrapped around the cable **420**. FIG. **5C** also shows the audio clicker **454**. According to the embodiment as shown in FIG. **5C**, the sensor **450** also includes a dome shaped magnet **456** for magnetically anchoring the cable tension sensor **450** to the surface **401**. The magnet **456** may also be a high-pull magnet. Because the magnet **456** is dome shaped, the magnet **456** resists hydrodynamic forces, thereby maintaining an attachment to the surface **401** even while the water vessel is operating.

As shown, the clicker **454** is attached to the magnet **456** by a pair of strings/wires **457**. The clicker **454** is also attached to the noose **452** by a string/wire **453**. In operation, when the cable **420** tugs the noose **452** to an extent that indicates that a desired cable tension has been reached, the connected audio clicker **454** transmits an audio click, indicating to an operator, such as a diver, that the desired cable tension has been ascertained. Returning to FIG. **5A**, although the figure shows only one cable tension sensor **450**, the arrangement **400** may include additional cable tension sensors **450** along the cable path.

FIG. **5B** is an exemplary illustration of a cable clamping arrangement **475** for securing a cable to a submerged hull surface, according to an embodiment of the invention. The arrangement **475** is similar to that of FIG. **5A**, with like elements being numbered accordingly. FIG. **5B** shows a submerged ferrous hull surface **401**. FIG. **5B** also shows a data collection device **410** such as a camera, and a signal carrying cable **420** extending from the device **410**. FIG. **5B** also shows a plurality of cable clamping devices **100**, gripping and clamping the cable **420** to the submerged ferrous hull surface

401. The features of each of the plurality of cable clamping devices **100** shown in FIG. **5B** are as outlined above with respect to FIGS. **1A-4**.

As shown in FIG. **5B**, the cable clamping arrangement **475** also includes a plurality of cable tension sensors **451** for determining when the cable is secured at a desired tension. In the arrangement **475** however, each sensor **451** is attached to a cable clamping device **100**. Similar to the cable tension sensor **450** as outlined with respect to the embodiment of FIGS. **5A** and **5C**, each cable tension sensor **451** has a noose **452** through which the cable is threaded, and an audio clicker **454** attached to the noose **452**. However, each audio clicker **454** is directly attached to the housing **101** of the respective cable clamping device **100**, as opposed to being attached to the surface **401**. As shown, each sensor **451** may be attached by a pair of wires **467**, attached at extreme sides of the housing **101**, thereby providing stability to the arrangement. Thus the cable tension sensors **451** do not require magnets. Regarding the tension sensing operations, the sensors **451** operate similarly to the sensor **450**, as outlined above. Because each sensor **451** is mounted on the housing **101** of a respective clamping device **100**, a cable tension determination can be made at each clamping location.

Regarding the cable clamping arrangements **400** and **475** as outlined above, and as illustrated in FIGS. **5A** and **5B**, these arrangements illustrate only one cable **420** being held by the cable clamping devices **100**. It should be noted that according to embodiments of the invention, multiple cables **420** may be held by the cable clamping devices **100**. As stated above, in embodiments of the cable clamping device **100** having the cable gripping member **250**, the rotatable cable cams **252** and **254** may be dimensioned to grip a plurality of cables **420** simultaneously, in which the cables **420** are vertically stacked. In embodiments of the cable clamping device **100** having the cable gripping member **260**, the form or rubber inserts **260** may be dimensioned to hold multiple cables.

Additionally, as outlined above, although the cable clamping device **100** with the low-profile housing **101** is particularly designed to withstand hydrodynamic forces when submerged on travelling water vessel, the cable clamping device **100** may be used in above-water applications, i.e., in situations when the device **100** is not submerged. Thus, according to another embodiment, the clamping arrangement **400** shown in FIG. **5A** may be applied in above-water applications. Similarly, the clamping arrangement **475** shown in FIG. **5B** may also be applied in above-water applications.

What has been described and illustrated herein are preferred embodiments of the invention along with some variations. The terms, descriptions and figures used herein are set forth by way of illustration only and are not meant as limitations. For example, although the underwater ferrous surface may be a submerged vessel surface such as the hull of a ship, the underwater ferrous surface may a submarine hull surface. Those skilled in the art will recognize that many variations are possible within the spirit and scope of the invention, which is intended to be defined by the following claims and their equivalents, in which all terms are meant in their broadest reasonable sense unless otherwise indicated.

What is claimed is:

1. A cable clamping device for securing one or more cables to underwater ferrous surfaces, the cable clamping device comprising:

- a low-profile housing body being substantially dome shaped, the low-profile housing body comprising:
- a first outer section having a first bore for receiving a first magnet;

9

a second outer section having a second bore for a second magnet;
 a middle section having a bottom arch portion defining a cable receiving opening, the middle section extending from the first outer section to the second outer section, wherein the first outer section, the second outer section, and the middle section form a truncated n-shaped side profile;
 the cable clamping device further comprising:
 a first magnet within the first bore;
 a second magnet within the second bore; and
 a cable gripping member within the bottom arch portion of the middle section for gripping the one or more cables within the cable receiving opening.

2. The cable clamping device of claim 1, further comprising a faraday cage that prevents the first and second magnets from interfering with any signal travelling through the one or more cables, wherein the faraday cage comprises, a flat elongated steel bar having a first connecting protrusion at one end attached to the first magnet, and a second connecting protrusion at another end attached to the second magnet, wherein the faraday cage is positioned within the housing body, extending from the first outer section through the middle section to the second outer section.

3. The cable clamping device of claim 2, wherein the low-profile housing body further comprises a first substantially flat base portion and a second substantially flat base portion, wherein the bottom arch portion is between the first substantially flat base portion and the second substantially flat base portion, and wherein the first magnet is exposed at the first substantially flat base portion and the second magnet is exposed at the second substantially flat base portion, so that each of the first and second magnets directly contact the underwater ferrous surface, and wherein each of the first and second magnets are high-pull rare earth magnets, each having a pull of at least 50 lbs.

4. The cable clamping device of claim 3, wherein the low-profile housing body further comprises a plurality of grooves in the first and second substantially flat base portions, the cable clamping device further comprising a plurality of rubber pads secured within the plurality of grooves, the plurality of rubber pads contacting the underwater ferrous surface, thereby increasing friction between the cable clamping device and the underwater ferrous surface.

5. The cable clamping device of claim 4, wherein the low-profile housing body further comprises first and second elongated handle grooves in the middle section forming a handle.

6. The cable clamping device of claim 5, wherein the cable gripping member within the bottom arch portion of the middle section comprises:

- a first rotatable cable cam biased to rotate in a first direction; and
- a second rotatable cable cam biased to rotate in a second direction opposite to first direction, wherein the cable extends between the first and second rotatable cable cams, and wherein the cable is maintained at a desired tension by the oppositely biased first and second rotatable cams, thereby preventing the one or more cables from slipping or excessively vibrating.

7. The cable clamping device of claim 5, wherein the cable gripping member within the bottom arch portion of the middle section comprises a foam insert lining the bottom arch portion, wherein the foam insert presses against and grips the one or more cables, thereby preventing the one or more cables from slipping or excessively vibrating.

8. A cable clamping arrangement for securing a cable to a submerged hull surface, the arrangement comprising:

10

a submerged ferrous hull surface;
 a cable for carrying signals;
 a plurality of cable clamping devices; and
 one or more cable tension sensors for determining when the cable is secured at a desired tension, wherein each of the cable clamping devices are magnetically attached to submerged ferrous hull surface, wherein the cable is held along the submerged ferrous hull surface in a desired path by the plurality of cable clamping devices, wherein the cable is in working contact with the cable tension sensor ensuring that the cable is extended at the desired tension, wherein each of the plurality of cable clamping devices comprises:

a low-profile housing body being substantially dome shaped, the low-profile housing body comprising:
 a first outer section having a first bore for receiving a first magnet;
 a second outer section having a second bore for a second magnet;
 a middle section having a bottom arch portion defining a cable receiving opening, the middle section extending from the first outer section to the second outer section, wherein the first outer section, the second outer section, and the middle section form a truncated n-shaped side profile;
 each cable clamping device further comprising:
 a first magnet within the first bore;
 a second magnet within the second bore; and
 a cable gripping member within the bottom arch portion of the middle section for gripping the cable within the cable receiving opening.

9. The cable clamping arrangement of claim 8, wherein each of the plurality of cable clamping devices further comprises a faraday cage that prevents the first and second magnets from interfering with the signal travelling through the cable, wherein the faraday cage comprises, a flat elongated steel bar having a first connecting protrusion at one end attached to the first magnet, and a second connecting protrusion at another end attached to the second magnet, wherein the faraday cage is positioned within the housing body, extending from the first outer section through the middle section to the second outer section.

10. The cable clamping arrangement of claim 9, wherein in each of the plurality of cable clamping devices, the low-profile housing body further comprises a first substantially flat base portion and a second substantially flat base portion, wherein the bottom arch portion is between the first substantially flat base portion and the second substantially flat base portion, and wherein the first magnet is exposed at the first substantially flat base portion and the second magnet is exposed at the second substantially flat base portion, so that each of the first and second magnets directly contact the submerged ferrous hull surface, and wherein each of the first and second magnets are high-pull rare earth magnets having a pull of at least 50 lbs.

11. The cable clamping arrangement of claim 10, wherein in each of the plurality of cable clamping devices, the low-profile housing body further comprises a plurality of grooves in the first and second substantially flat base portions, each cable clamping device further comprising a plurality of rubber pads secured within the plurality of grooves, the plurality of rubber pads contacting the submerged ferrous hull surface, thereby increasing friction between the cable clamping device and the submerged ferrous hull surface.

12. The cable clamping arrangement of claim 11, wherein in each of the plurality of cable clamping devices, the housing

11

body further comprises first and second elongated handle grooves in the middle section forming a handle.

13. The cable clamping arrangement of claim 12, wherein each of the one or more cable tension sensors comprise a noose through with the cable is threaded, and an audio clicker, wherein the noose is attached to the audio clicker, and wherein when the cable tugs the noose to an extent that indicates that a desired cable tension has been reached, the audio clicker transmits an audio click, indicating to an operator that the desired cable tension has been ascertained.

14. The cable clamping arrangement of claim 13, wherein in each of the plurality of cable clamping devices, the cable gripping member within the bottom arch portion of the middle section comprises:

a first rotatable cable cam biased to rotate in a first direction; and

a second rotatable cable cam biased to rotate in a second direction opposite to first direction, wherein the cable extends between the first and second rotatable cable cams, and wherein the cable is maintained at a desired

12

tension by the oppositely biased first and second rotatable cams, thereby preventing the cable from slipping or excessively vibrating.

15. The cable clamping arrangement of claim 13, wherein in each of the plurality of cable clamping devices, the cable gripping member within the bottom arch portion of the middle section comprises a foam insert lining the bottom arch portion, wherein the foam insert presses against and grips the cable, thereby preventing the cable from slipping or excessively vibrating.

16. The cable clamping arrangement of claim 13, wherein each audio clicker of the one or more cable tension sensors is attached to the housing of a respective one of the plurality of clamping devices, so that each clamping device is attached to a cable tension sensor.

17. The cable clamping arrangement of claim 13, wherein the one or more cable tension sensors comprise a plurality of cable tension sensors, wherein each of the plurality of cable tension sensors is mounted on a low-profile housing body of a respective one of the plurality of cable clamping devices.

* * * * *